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FOOD HABITS OF FOUR SYMPATRIC COLUMBIDS (AVES: COLUMBIDAE) IN ZARIA, NIGERIA

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ABSTRACT
The crop contents (regurgitates) of 154 Columbids comprising of 88 (57%) *Streptopelia sensgalensis*, 20 (13%) *Streptopelia semitorquota*, 21 (14%) *Streptopelia decipiens* and 25 (16%) *Columba guinea* trapped in the wild in Zaria and its environs were examined from May 1998 to February 1999. The aim of the study was to assess the food habits of the Columbids and to illustrate the concept of niche overlap and differentiation which may aid in the management and possible domestication of these species within the study area. Forty- eight food organisms (i.e. species or other taxa that served as food for the Columbids) were isolated from the crop contents of the birds through the administration of an emetic which induced the birds to regurgitate their crop contents. These included wild and cultivated plant seeds as well as some animal materials. Thirty-eight of the forty-eight food–organisms were isolated from *S. senegalensis*, 25 from *S. semitorquata*, 20 from *S. decipiens* and 30 from *Columba guinea*. *Sorghum bicolor* was the most frequent food-organism, having been found in the regurgitates of 136 (82.6%) of the 154 birds. *Sorghum bicolor* appeared to be the most important food component in the habitats of Columbids in Zaria.
Analyses of regurgitates showed a food niche over lap of 31.3% and a total food niche differentiation of 33.5% between the four Columbid species studied.

KEY WORDS: Food habits, regutgitates, sympatric, Columbids, Zaria, Nigeria

INTRODUCTION

Columbids (Pigeons and Doves) are members of the bird family Columbidae. Goodwin (1983), described the Columbidae as a large and successful family of birds. Columbids are most unique among birds in their production of crop milk and in their drinking habits.

They are world-wide in distribution, with different species found in the various zoogeographical regions of the world. Elgood *et al*. (1994) identified 19 species for Nigeria, 15 of which occur in the Nigerian Northern Guinea Savanna, under which the Zaria area falls.

The first human impression about Columbids was that of a symbol of peace, love and fertility (Kligerman, 1978). Columbids are generally very tasty and therefore much sought after by predators including humans for food.

In Nigeria, Columbids have been hunted and eaten by humans. This no doubt provides an indication of their present culinary and economic importance as a hunted wildlife in Nigeria (Oniye *et al*., 2000).
Columbids in Zaria also suffer massive assaults from a multiplicity of human agents and activities such as habit destruction and indiscriminate hunting. These perharps place them at the risk of endangerment and also threatened with extinction or extirpation.

Although the concepts of competition, niche overlap and separation have been investigated in some bird species, there is no specific study of these concepts as they relate to Columbids of the Afrotropical savanna (Ezealor, 1985).

This study was therefore, designed with the aim of providing baseline information on the food habits of wild Columbids in Zaria area using crop content analysis.

MATERIALS AND METHODS

One hundred and fifty-four (154) Columbids were trapped in localities around Zaria (location $11^{o}3^{1}$ NN and 7^{o} 42^{1} NE) in Kaduna State Nigeria.

The birds were trapped using locally made live-bait traps and also locally made string and wire traps from May 1998 to February 1999.

As soon as a bird was caught, a dose of an emetic Ipecac® (Ipecacuanha from *Cephaelis ipecacuanha*) was administered to it. Through trial doses of the emetic, it was observed that about 3 ml of emetic induced regurgitation in *Streptopelia senegalensis* (Laughing Dove), 4 ml in *Streptopelia semitorquata* (Red–eyed Dove) and *Streptopelia decipiens* (Mourning Dove) and 5 ml in *Columba guinea* (Speckled Pigeon). This chemical caused the bird to regurgitate its crop content.

The administration of the emetic was done according to the procedure described by Prys-Jones *et al*. (1985) and Tomback (1975). After the administration of the emetic the bird was placed in a dark cardboard box with the floor lined with absorbent paper to absorb any liquid present in the regurgitates. After about 30 to 45 mins, the bird regurgitated its crop content and thereafter was released back into the wild. All regurgitated materials were collected and stored in 5% formalin in specimen bottles for identification and analyses in the laboratory.

Each regurgitate was poured into a petri dish and its various food items sorted out. Identifiable contents of the crop (regurgitates) were sorted out by species.

Seeds that could not be identified directly were sown in pots and watered daily to enhance germination. The germinated food plants were identified at some stage of their growth and development.

Some of the food items were identified based on the area in which the bird was caught. A survey of the seed plants was made particularly around the immediate vicinity of catch. The seeds were then compared with those recovered from the regurgitates for possible identification. This was mostly done for tree seeds. Food items that could not be identified by any of these means, were photographed and tagged as unidentified. Identification of seeds was done with the aid of herbarium specimens of the Department of Biological Sciences and Department of Plant Science, Ahmadu Bello University, Zaria. The method used for the assessment of the crop contents was frequency of occurrence adapted from Ricker (1968).
To calculate the percentage niche overlap and differentiation, the formula below was used:

$$X/48 \times 100 = Y$$

X = Number of food items over-lapping or differentiating.
48 = Total number of food items observed in the study.
Y = Percentage over-lap or differentiation.

Statistical procedures described by Sokal and Rohlf (2000) and Mann-Whitney test, were used to compare possible differences in food habits between the various Columbids.

RESULTS

A total of 154 regurgitates were collected from 88 *Streptopelia senegalensis*, 20 *Streptopelia semitorquata*, 21 *Streptopelia decipiens* and 25 *Columba guinea*. A total of forty-eight food–organisms were recovered from the regurgitates of the four Columbids (Table 1).

Thirty-eight of the forty-eight food-organisms were isolated from the regurgitates of *Streptopelia senegalensis*, 25 from *Streptopelia semitorquata*, 20 from *Streptopelia decipiens* and 30 from *Columba guinea* (Table 1).

Table 1: Food organisms observed in regurgitates of wild Columbids in Zaria, Nigeria

		Streptopelia senegalensis (n=88)	*Streptopelia semitorquata* (n=20)	*Streptopelia decipiens* (n=21)	*Columba guinea* (n=25)	Percentage Frequency (%)
	a) Cultivated seeds	84	14	16	22	88.3
	Sorghum bicolor	81	13	14	21	83.8
	Oryza sativa (unhusked)	73	13	15	21	79.2
	Zea mays	50	09	14	14	56.5
	Pennisetum typhoides	45	09	09	19	53.2
	Arachis hypogea	49	10	13	16	57.1
	Vigna unguiculata (seeds)	42	08	08	14	46.8
	Glycine max	20	05	06	00	20.1
	Cucumis melo	08	00	00	04	7.8
	Hibiscus esculentus	35	00	00	07	27.3
	Spathodea campanulata	47	11	10	00	44.2
	Amaranthus spinosus	02	01	00	00	1.9
	Capsium annum	21	02	00	00	13.6
	Lycopersicum esculentum	00	00	04	00	2.6
	Vigna unguiculata (Cotyledons)					
	b) **Wild seeds**	51	11	11	16	57.8
	Brachiaria lata	27	07	08	12	35.1
	Setaria pallide-fusca	28	00	00	09	24.0
	Panicum phragmitoides	10	00	00	00	6.5
	Sporobolus pyramidalis	12	00	00	00	7.8
	Commelina sp	11	00	00	00	7.1
	Cassia occidentalis	04	00	00	04	5.2
	Cassia tora	07	00	00	00	4.5
	Crotolaria sp	44	08	13	18	53.9
	Vigna reticulata	03	00	00	06	5.8
	Luffa aegytica	00	00	00	08	5.2

	Unidentified (1)	04	02	00	00	3.9
	Unidentified (2)	00	00	00	07	4.5
	Unidentified (3)	00	00			2.6
	Unidentified (6)	02	00	00	00	1.3
	Calopogonium mucunoides	08	01	01	04	9.1
	Corchurus oleitorius	03	00	00	01	2.6
	Sesamum radiatum	02	00	00	00	1.3
	Indigofera arrecta	00	00	03	03	3.9
	Monechma cilliata	00	00	00	02	1.3
	Hibiscus suratensis	00	01	00	02	1.9
	c) **Tree seeds**					
	Pisidium guajava	03	00	00	00	1.9
	Carica papaya	05	00	00	00	3.2
	Eucalyptus citriodora	40	00	00	12	33.8
	Azadirachta indica	09	00	00	00	5.8
	d) **Animal materials**					
	Papilio sp	00	02	00	00	1.3
	Termes bellicosus	04	04	03	01	7.8
	Lumbricus terrestris	04	02	00	02	5.2
	Polyxenus sp	00	01	00	00	0.65
	e) **Miscellaneous food items**					
	Oryza sativa (husked)	25	00	00	09	22.1
	Unidentified leaves	23	04	05	14	29.9
	Unidentified insect parts	06	07	03	08	15.6
	Sand and grit particles	20	06	05	08	25.3

There were statistically significant differences in the frequency of occurrence of each food-organism within the four sympatric Columbids and within each Columbid.

Fifteen (31.3%) of the food-organisms were common to all the four Columbids, these included; *Sorghum bicolor, Oryza sativa* (unhusked), *Zea mays, Pennisetum typhoides, Arachis hypogea, Vigna unguiculata* (seeds), *Glycine max, Brachiaria lata, Setaria pallide-fusca, Vigna reticulata, Calopogonium mucunoides*, unidentified leaves, *Termies bellicosus*, unidentified insect parts and sand and grit particles.

Two food-organisms (4.2%) *Cucumis melo* and *Amaranthus spinosus* were common to *S. senegalensis, S. semitorquata* and *S. decipiens*. One food-organism (2.1%) *Lumbricus terrestris* was common to *S. senegalensis, S. semitorquata* and *C. guinea*. Three food-organisms (6.3%), Capsium annum, Lycopersicum esculentum and unidentified (2) were common to *S. senegalensis* and *S. semitorquata*. Seven food-organisms (16.7%), *Hibiscus esculentus, Spathodea campanulata, Panicum phragmitoides, Luffa aegyptica, Cassia tora, Corchurus oleitorius* and *Oryza sativa* (husked) were common to *S. senegalensis* and *C. guinea*. Two food-organisms (4.2%), *Hibiscus suratensis* and unidentified (5) were common to *S. semitorquata* and *C. guinea*.

Nine of the forty-eight food-organisms (18.8%) comprising of *Sporobolus pyramidalis, Commelina* sp, *Cassia occidentalis, Crotolaria* sp, unidentified (6), *Azadirachta indica* seeds, *Pisidium guajava* seeds, *Carioca papaya* seeds and *Sesamum radiatum* were found exclusively in the regurgitates of *S. senegalensis*. *Papilio larvae* and *Polyxenus* sp (4.2%) were found exclusively in *S. semitorquata*, *Vigna unguiculata* (cotyledons) and unidentified (4) (4.2%), were exclusively from the regurgitates of *S. decipiens* while unidentified (1), unidentified (3) and *Monechma cilliata* (6.3%) were found exclusively in regurgitates of *C. guinea*. This gives a total niche differentiation of 33.5%.

Figure 1 presents a Venn diagram illustration of niche overlap and differentiation in food habits of the four Columbids studied.

U =

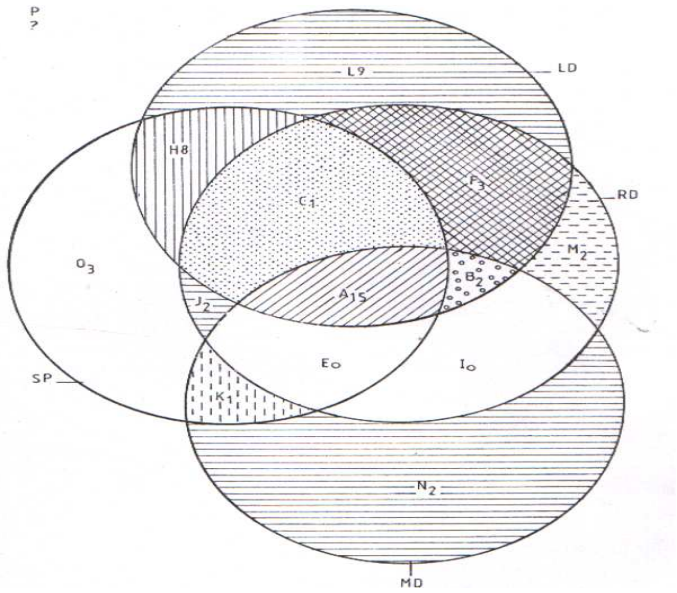

Figure 1: Venn diagram of niche overlap and differentiation in food habits of four sympatric Columbids in Zaria

KEY TO FIGURE 1
U = Universal set of the 48 food-oganisms observed in regurgitates of the four Columbids, including other food-organisms present in the environment on which the birds may probably feed but not observed in the regurgitates of the sampled birds.
? = Food items present in the environment on which the birds may probably feed but not observed in the regurgitates of the sampled birds.
LD = Set of food-organisms observed in the regurgitates of *S. senegalensis*
RD = Set of food-organisms observed in the regurgitates of *S. semitorquata*.
MD = Set of food-organisms observed in the regurgitates of *S. decipiens*.
SP = Set of food-organisms observed in the regurgitates of *C. guinea*.
A = Food-organisms common to all the four species.
B = Food-organisms common to *S. senegalensis*, *S. semitorquata* and *C. guinea* only.
C = Food-organisms common to *S. senegalensis*, *S. decipiens* and *C. guinea* only.
E = Food-organisms common to *S. semitorquata*, *S. decipiens* and *C. guinea* only.
F = Food-organisms common to *S. senegalensis* and *S. semitorquata* only.
H = Food-organisms common to *S. senegalensis* and *C. guinea* only.
I = Food-organisms common to *S. semitotquata* and *S. decipiens* only.
J = Food-organisms common to *S. semitorquata* and *C. guinea* only.
K = Food-organisms common to *S. decipiens* and *C. guinea* only.
L = Food-organisms common to *S. senegalensis* only.
M = Food-organisms common to *S. semitorquata* only.
N = Food-organisms common to *S. decipiens* only.
O = Food-organisms common to *C. guinea* only.
P = Food-organisms not observed in the regurgitates of any of the four Columbids but may be present in the environment and on which the birds may feed.

DISCUSSION

The variety of food-organisms recovered from the regurgitates of the Columbids shows that these species are europhagous (Rowan, 1983).

Streptopelia senegalensis with the highest number of food-organisms recovered (38) appears to be the most euryphagous, followed by *C. guinea* (30), *S. semitorquata* (25) and *S. decipiens* (20). In terms of frequency of occurrence in the diet of these Columbids, cultivated and wild seeds appear to be very important food-organisms in these Columbids. This agrees with the findings of Rowan (1983) and Goodwin (1983), who reported cultivated and wild seeds as important food items for Columbids.

Among the cultivated seeds, *Sorghum bicolor* was important with respect to frequency of occurrence in all the four Columbids. Among the wild seeds, *Brachiaria lata* was the most important with respect to frequency of occurrence in *S senegalensis* and *S. semitorquata* while *Vigna reticulata* was the most important *S. decipiens* and *C. guinea* (Rowan, 1983). Among the tree seeds, the seeds of *Eucalyptus citriodora* were the most important in *S. senegalensis* and *C. guinea*. Among the animal materials, unidentified insect parts were the most important food-organisms in terms of frequency of occurrence in all the four Columbids. Other animal materials recovered were *Termes bellicosus* and *Lumbricus terrestris*. These food-organisms have been implicated as intermediate hosts of some helminths (Soulsby, 1982). It is therefore safe to assume that Columbids may acquire helminth infections from their diets particularly as the diet of birds according to Malhotra and Capoor (1980), has been known to a greater extend to determine the composition of their parasitic fauna.

However, these animal materials are vital to egg formation as well as the accumulation of body fats that metabolized during incubation and chick rearing (Mbinkar *et al*., 2005).

Any habitat management for these Columbids should ensure the availability of these important food-organisms. Other food-organisms that may be similarly considered are *Oryza sativa, Zea mays, Pennisetum*

typhoides, Vigna unguiculata, Arachis hypogea, Amaranthus spinosus, Glycine max, Setaria pallide-fusca which also rated high in their frequency of occurrence as food for these Columbids.

Differences in the frequency of occurrence of the various food-organisms within the Columbids and within each of the Columbids, were mainly discernible with respect to the various food-organisms available and the food preference of the Columbids at any point in time.

The habit of feeding on cultivated plant seeds exhibited by these Columbids may cause them to become implicated as crop pests (Rand, 1965; Mellandy, 1967). However, no reports have been made in Zaria area of these species depredating on farm crops. Conversely, the agro-ecological values of their prodigious consumption of wild seeds are note worthy. Adang (1999) argued that doves feeding on wild seeds (a form of biological control) probably help to reduce the impact of weeds on farm crops. Further more, the presence of these birds on farmlands may, as observed by Verne (1940), provide fertilizers through their droppings thereby supplementing the use of artificial fertilizers.

The feeding of the birds on some common food-organisms particularly on cultivated seeds is an invariable indication of some form of competition. This brings about a niche overlap in the food habit of these Columbids. However, the wide variety of food-organisms present in the environment may help to reduce the intensity of the competition and has probably contributed to their sympatricity. A percentage niche over lap of 31.3% probably shows less competition for food by these Columbids.

By way of niche differentiation, the various Columbids selected food-organisms (seeds) of different sizes and this could be correlated to the bill size. Kreb and Davies (1979), acknowledged the fact that birds with large bills tend to select large-size food organisms while birds with small bills tend to select small-size food-organisms. *C. guinea* with with a large bill differentiated its niche by feeding on large size seeds such as *Zea mays*, *Arachis hypogea* and *Vigna unguiculata* while *S. senegalensis, S. decipiens* and *S.* semitorquata with relatively small bills fed on small size seeds. *S. senegalensis* with a niche differentiation of 18.8% differentiated its niche by feeding on a variety of food-organisms. , *S. semitorquata* by showing more affinity for animal material such as *Papilio* sp and *Polyxenus* sp could help differentiate its niche from that of the other species. , *S. decipiens* being the only Columbid feeding on *Vigna unguiculata* cotyledons could help different its niche. A niche differentiation of 33.3% though not significantly higher than the 31.3% niche overlap, could be responsible for the sympatricity or coexistence of these Columbids in the Zaria area.

CONCLUSION

In conclusion, the Columbids of Zaria, Nigeria are euryphagous, thus any attempts to domesticate the birds must consider the organisms they feed on. The presence of 48 food-organisms observed in the present study amongst other food-organisms not observed but which may be available in the environment possibly indicates that Zaria area could be a good site for the conservation of these Columbids. Agricultural development particularly in the growing of cereals in the Zaria area has probably provided a super habitat for these seed-eating Columbids.

The disparity in the frequency of occurrence of food-organisms available to these Columbids is vital for rearing and domesticating any of these Columbids and worth incorporating in habitat management. The idea of niche overlap and differentiation, may be useful in feeding of these Columbids both in the wild and in captivity or under domestication.

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